Environmental Science

The role of fresh groundwater discharge in the dispersion and re-circulation of salt in Estuarine Sediments

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In estuarine environments significant groundwater systems exist that discharge fresh water into the near shore surroundings. This fresh groundwater can be mixed with salt water in the upper few decimeters of the sediment. As a result, net measured discharge rates at the sediment-water interface are equal to the volume discharge of fresh groundwater although the salinity of the escaping water is high. Seepage meters were used to measure discharge rates over about 50 l/day/m^2 near the shoreline of The Great South Bay, a wide, shallow lagoon with a tidal range of ~0.21m situated at the surface of a coastal plain aquifer along the South Shore of Long Island, New York. These rates decreased to 15 l/day/m^2 at a distance of 100 m from shore. No consistent variation in discharge with tidal phase was found, but water collected at sampling locations freshened over time from 30 ppt to 23 ppt in twelve hours demonstrating a freshening of any salt penetrated sediment beneath the seepage meter and suggesting that the use of seepage meters "turns off" the mixing process. Piezometers recorded vertical hydraulic gradients (at ambient salinity, 28 ppt) between 0.08 and 0.02 in the upper meter of the sediment and the vertical hydraulic conductivity was measured by a falling head test to be between 1 and 20 m/day. Conductivity measurements showed the pore water salinity decreasing from ambient bay values at the surface to near fresh water values at a depth of 0.6m. The vertical downward dispersion coefficient for salt was estimated to be 0.02 m^2/day. Both wave induced transport and gravitational convection (salt fingering) into the sediments are considered possible mechanisms driving salt penetration that must be studied.